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CULTURE - OF - THE - LOGAN - BLACKBERRY AND RELATED VARIETIES



THE LOGAN BLACKBERRY, formerly thought to be a hybrid between a blackberry and a red raspberry, is now considered a variety of the Pacific coast species of trailing blackberry.

It is adapted to the milder parts of California, Oregon, and Washington where the temperature does not reach zero Fahrenheit, but so far as known it does not succeed in any place east of the Cascade and Sierra Ranges. While the plants may survive in some sections of the South, they do not fruit well, and they are not hardy in the Northern States.

In this bulletin, directions are given for planting, training, and pruning the plants and for harvesting and utilizing the fruit. The information should be especially valuable for those who plan to grow this variety either commercially or in their home gardens, as well as for those who grow other kinds of blackberries.

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CULTURE OF THE LOGAN BLACKBERRY AND RELATED VARIETIES.¹

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STATUS OF THE INDUSTRY.



URING the last few years much interest has been shown in a type of trailing blackberry which is grown chiefly in California, Oregon, and Washington. The Logan blackberry is the most important variety of this type, and its fruit is especially well adapted to several commercial uses. Large quantities are marketed in the fresh state, not only in towns and cities of the States in which it is grown but also in the Mountain States and the Middle West. It is evaporated extensively

for the dried-fruit market, and large quantities are canned, preserved, and made into jams and jellies. Recently a large part of the crop has been utilized for the production of a nonalcoholic beverage. The juice of the Logan blackberry is of superior quality and is preferred by many to that of any other fruit. Because this variety is adapted to these different commercial uses, raising and marketing the fruit has rapidly assumed considerable importance in the sections adapted to its culture.

¹ The word "Logan" is applied here to the berry popularly known as the Loganberry. It was first called the "blaspberry" (a word made by combining the first two letters of the word "blackberry" with the last eight letters of the word "raspberry").

In this bulletin the methods of cultivating the Logan blackberry are described, and as the culture of other varieties of this type, such as the Mammoth and Phenomenal, is not essentially different, the methods for the most part apply to them also. Wherever their treatment differs to any extent that fact is noted in the descriptions presented on pages 23 and 24.

ORIGIN OF THE VARIETY.

The Logan blackberry is commonly known as the Loganberry. It was discovered in 1881 by Judge J. H. Logan, of Santa Cruz, Cal., growing from seed planted in his garden. This seed was gathered from a bush of the Aughinbaugh variety of the trailing blackberry of the Pacific coast, adjacent to which were growing a red raspberry and the Crandall blackberry. Because the fruit of the seedling was red in color and because it was much more productive than the Aughinbaugh, Judge Logan supposed it to be a hybrid. The subsequent growing of many seedlings from this plant, which invariably produced fruit similar in color to that of the original seedling, was, in his opinion, still further evidence of a convincing character that the original was a hybrid. All the other seedlings raised at the same time were quite distinct and seemed to be hybrids between the Aughinbaugh and the Crandall blackberry. He, therefore, felt sure that the red-fruited seedling must be a natural hybrid between the Aughinbaugh blackberry and the red raspberry, and it has commonly been supposed to be such a hybrid.

Recent investigations, however, make it reasonably certain that instead of being a hybrid, this fruit is, in fact, a variety of the Pacific coast form of trailing blackberry, and should, therefore, be termed a blackberry. In no important botanical characteristic does the Logan differ from the wild blackberry of the Pacific coast. When crossed with the raspberry or blackberry it does not exhibit hybrid characteristics, but acts like a variety of a true species. The fact that the red color of the fruit is reproduced in the seedlings, which Judge Logan considered evidence of hybridity, is, on the contrary, strong evidence that the Logan variety is not the result of a cross. Other varieties grown on the Pacific coast which produce black fruit are indistinguishable from the Logan, so far as specific botanical characters of the plant are concerned; and, further, there is authority for the statement that wild forms occur which bear red fruit. The Logan, therefore, is considered a red-fruited variety of the wild trailing blackberry of the Pacific coast.

The roots of the Logan blackberry are perennial, that is, they live for many years. The canes are biennial, growing one year and dying after fruiting the following year. They take root at the tips, like dewberries, and do not send up suckers from the roots,

like red raspberries. The fruit resembles a large blackberry in shape, but has the color of the red raspberry. (Fig. 1.) When very ripe it becomes dark purplish red. It has a brisk acid flavor, which becomes milder and quite palatable when the fruit is allowed to ripen fully on the vines. Figure 1 shows pint boxes of the Logan blackberry and of the Phenomenal blackberry, which closely resembles the Logan.

EXTENT OF CULTURE.

The Logan blackberry is now a standard fruit for home gardens and local markets in California, Oregon, and Washington, especially west of the Cascade and Sierra Ranges. Large quantities are grown in the vicinity of the larger cities for the local markets. The largest centers of production, however, are Sebastopol, Cal., and



FIG. 1.—Pint boxes of Logan blackberries (on the left) and of the Phenomenal (on the right). The Phenomenal berries are larger, and occasionally double fruits are seen.

the Willamette Valley of Oregon. From both these localities extensive shipments are made of the fresh fruit or its products. In the State of Washington no extensive centers have been developed, since the canes suffer more or less from winter injury except in the lower Columbia River Valley and in very protected places in the Puget Sound region.

Small plantings of the Logan blackberry have been made in Utah and in the cooler sections of Arizona, but it is not generally adapted to the climates of these States. It has been tested in many parts of the Central and Eastern States, but does not thrive. In regions east of the Pacific Coast States, where the temperature falls to zero Fahrenheit, the canes have been winterkilled, while in the Southern States the summer climate seems unfavorable. Until further testing has determined whether it is possible to overcome the unfavor-

able climatic conditions prevailing in the South, the variety is recommended for general planting only in the milder parts of California, Oregon, and Washington.

LOCATION AND SITE OF THE PLANTATION.

It is obvious that in selecting a location for a plantation the possibility of marketing the fruit profitably, the condition of the roads to the markets, adequate refrigeration and railroad transportation service where such are required, ample irrigation water where irrigation is needed, a sufficient supply of labor to harvest the crop, and the climatic conditions of a section all need to be taken into consideration. In some places violent winds may injure the canes and foliage. It is especially important to know whether in this and in other respects the local climatic conditions favor the development of a plantation, and this can be determined best by getting the experience of local berry growers.

In the selection of a site for a plantation the character of the soil, the water drainage, and protection against wind should be considered. The Logan blackberry will thrive on any deep, fertile, well-drained soil, but the crops will be largest on the richest soils.

In sections where strong winds occur at certain seasons, a site as protected as possible should be selected. Sometimes it may be desirable to plant on the windward side a windbreak of some suitable tree or shrub. Large commercial plantations, however, should rarely be planted in regions having very severe winds, as the cost of production will be too great.

PREPARATION OF THE SOIL.

As with other berries and garden crops, it will pay well to have the soil in good condition before the plants are set. The plants should not be set in recently broken sod land, but in a field which has previously been planted to a crop requiring a fine, deep seed bed and receiving much tillage. It will prove easier and cheaper to make the soil fertile and to put it in good physical condition before the plantation is set than afterwards.

In Oregon and Washington the field should be plowed in the autumn and replowed in the spring. The soil should then be thoroughly pulverized with a harrow. In California the methods of preparing the soil vary widely in different sections, but good practice always demands that it be deeply and finely pulverized.

SETTING THE PLANTS.

In Oregon and Washington the plants should be set in early spring, not later than the middle of April, usually in March. Farther south, in California, they should be set as soon as the young

plants have grown large enough to transplant, usually in January. Planting should not be delayed until there is danger that the summer drought may come before the plants are thoroughly established in the soil.

For commercial plantations in Oregon and Washington the plants should be set 8 feet apart in rows which are 8 feet distant. To set an acre so spaced 680 plants will be required. On very rich soils they are sometimes set 10 or 12 feet apart in rows which are 8 feet distant. In some parts of California this variety does not grow as vigorously as in the other States mentioned, and consequently the plants should be set 6 feet apart in rows which are 8 feet distant. In the Sebastopol section of California, however, the plants should be at least 8 feet apart in the rows, and some growers prefer to set them 12 feet apart in the rows. For home gardens in all sections they may be planted as close as 6 feet apart each way.

"Tip" plants, that is, plants which have formed during the autumn and winter at the end of the year-old canes, are generally used to start a new plantation. Such plants are more tender than nursery plants of most other fruits, and exposure to the sun and wind, or storage out of the ground for any length of time seriously weakens them. Nearly all plantations have to be partially reset to replace the loss which results from injury to the young plants. It is possible, however, by protecting the young plants at setting time to secure a perfect stand the first year, and many growers have succeeded in doing this.

In order to secure a good stand the plants should be set in their permanent places in the field immediately upon arrival from the nursery. While the setting is being done, only a few plants should be dropped ahead of the setters, the rest being kept covered with wet burlap. If the roots of the plants seem somewhat dry they should be wet thoroughly before setting. When plants are to be shipped long distances, transplants, that is, tip plants which have been grown in the nursery for one season, ordinarily are preferred, as they withstand long shipments better than newly formed tip plants.

After the soil has been thoroughly pulverized the rows should be marked off. If the plantation is in a section having prevailing winds from a certain direction, the rows should always run parallel to the direction of the wind. Plants should be dropped and set at once. A spade is a convenient tool for use in planting. It is thrust into the ground and forced forward, the plant placed in the hole thus made, the spade withdrawn, and the earth firmed about the roots with the foot. When set in this manner the plant should be at least 2 or 3 inches deeper than it previously stood. Where there is danger of drought soon after planting the roots should extend to a depth of 5 or 6 inches below the surface of the ground.

For convenience in assembling the fruit after it has been picked the rows should not be more than 400 or 500 feet long. When the rows are very long the distance the fruit has to be carried by hand is too great; therefore, crossroads 10 or 12 feet wide, cutting the rows at right angles, should be provided at frequent intervals.

INTERCROPPING.

In gardens in some sections where the land must be used to the fullest extent possible, intercrops may be grown between the rows of Logan blackberries the first season after planting. The more

desirable crops are potatoes, beans, peas, and similar vegetables, which need intensive cultivation early in the season. As cultivation should ordinarily cease at the end of the summer, especially in those parts of

Oregon and Washington where there is danger from winter injury, crops which require cultivation until late autumn should be avoided.

Usually it is best to

set only one row of an intercrop between the berry rows. No crop should be raised the second year, as the berry roots should occupy all of the ground.

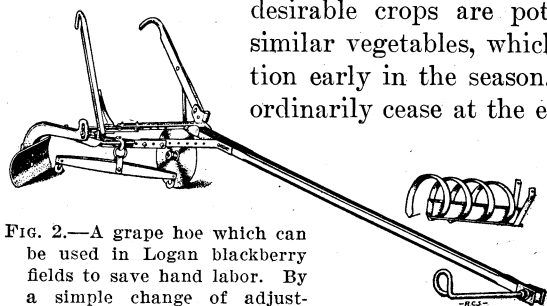


FIG. 2.—A grape hoe which can be used in Logan blackberry fields to save hand labor. By a simple change of adjustment the soil can be thrown toward the vine or bushes as well as taken away. The hoe is guided easily by the disk to which the handle is attached. The point of the hoe must not turn down when in use.

TILLAGE.

The Logan should have the same tillage through most of the growing season that other blackberries require. Such tillage should be thorough in early spring to keep down weeds, as well as during the summer to conserve moisture. Many growers consider it profitable to cultivate their fields at least once a week until after the fruiting season, in order to keep a dust mulch 2 or 3 inches deep over the entire surface. If the plants are set 8 feet apart each way, the cultivator can be run both ways the first year and less hoeing will be required. About midsummer the canes should be turned along the rows and the cultivator run in one direction only.

A tool called a "grape hoe" (fig. 2) can be used to good advantage in tillage. It is easily guided and can be run close to the plants in the row, so that very little handwork is necessary. Cultivation near the plants should always be shallow, so as not to disturb the roots, and the use of the grape hoe will make shallow cultivation possible at a low cost.

If the ground is nearly level, so that the drainage is not good in winter, a dead furrow should be made in the late autumn through the center of the space between the rows. The following spring the ground should be plowed away from the plants, so that the dead furrow will be filled, and later cultivation with a harrow or cultivator should level the surface again.

IRRIGATION.

In most parts of Oregon and Washington and in the Sebastopol section of California, sufficient moisture can be conserved by intensive cultivation, so that no irrigation ordinarily need be applied. In

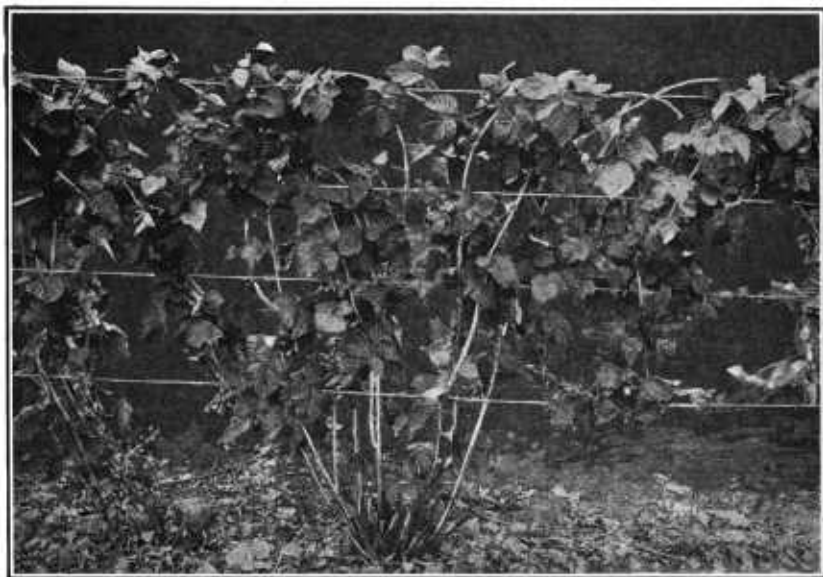


FIG. 3.—A Logan blackberry plant trained to four wires by the weaving system. P20369HP

other parts of California, however, it is usually necessary to irrigate. In the light soils of southern California irrigation sometimes becomes necessary every few days during the fruiting season. In such case it usually is best to irrigate alternate rows and to pick from the unirrigated rows; at the next irrigation the water should be applied to the rows not watered at the previous irrigation. In heavier soils and in other parts of California it is not necessary to apply the water so often, and once every two weeks from the end of the winter rains until the close of the fruiting season is usually sufficient. After the fruiting season water need be applied only occasionally.

A cultivator should be run through the spaces between the rows after each irrigation. Less water will be needed when this is done,

and the soil will be kept in a much better physical condition. The cultivation should be frequent enough to keep a dust mulch over the surface of the ground.

MAINTENANCE OF FERTILITY.

The soil on which Logan blackberries are grown should be deep, well drained, and fertile, and should contain a large quantity of humus. It is not thought that the use of commercial fertilizers will prove profitable under ordinary conditions. Many growers, however, have used stable manure systematically in their plantations and have increased their yields by this practice. Whenever obtainable at a reasonable price and where the plantation is not yielding over 3 tons per acre, it is probable that the application of stable manure will prove profitable. It can be used freely; growers sometimes apply as much as 20 tons per acre annually. Probably the chief advantage in



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FIG. 4.—A single plant of the Logan blackberry trained to three wires by the weaving system.

using stable manure is that it supplies large quantities of humus and thus increases the moisture-holding capacity of the soil.

Some growers use cover crops instead of stable manure, with good success. These crops should be planted in late summer or autumn after the fruit has been picked and whenever the soil is in such condition that the seed will start. Care must be exercised in using cover crops, as they may make a rank growth by spring and become difficult to control; if planted in drills in the alleys and plowed under before they spread into the rows of plants, they can be managed easily, and will supply humus and, in case of a leguminous crop, nitrogen also. Among the cover crops which are desirable in certain sections are the different kinds of peas, beans, clovers, and vetches, which supply both humus and nitrogen. Among the nonleguminous crops which may be used are rye, cowhorn turnips, and rape. As conditions vary so much in the different sections, an inexperienced grower should find out by inquiry among his neighbors which cover crop is considered best in his section for use in Logan fields and should use it until careful trial has convinced him that another is better.

TRAINING SYSTEMS.

In practically all sections, the canes are trained to a wire trellis which is made by setting posts about 30 feet apart in the rows, along which two or three wires are strung. Cedar posts are commonly used. These should be at least 7 feet long and set 2 or $2\frac{1}{2}$ feet in the ground. When three wires are used, they are strung along the posts at levels of about $2\frac{1}{2}$ feet, 3 feet 9 inches, and 5 feet from the ground. If two wires are used, they are placed about 2 feet and $4\frac{1}{2}$ feet from the ground. No. 12 or No. 14 wire may be used for these trellises.

Oregon and Washington growers generally use a 3-wire trellis, while California growers use the 2-wire trellis. Occasionally, in



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FIG. 5.—A Logan blackberry plant with its canes trained in accordance with the rope system.

sections having strong prevailing winds, a post is set by each plant and the canes trained directly to the post.

The canes of the Logan blackberry grow up from the ground in the early spring, and although they may be 30 feet long by autumn they are usually only 15 or 20 feet. They run in all directions along the surface of the ground unless trained in some manner. During the first season, therefore, they should be made to run along the rows, to keep them out of the way of the cultivator. Short sticks or pieces of wire are used to hold the canes in place along the rows, two or three such sticks or wires being necessary for each plant.

In the autumn of the first year or in the early spring of the following year, the canes should be trained to the trellis which, by that

time, should have been erected. There are two distinct methods of training in common use, the weaving system and the rope system. Both the weaving and the rope systems are used in Oregon, while some form of the rope system ordinarily is used in California. Washington growers prefer the weaving system.

When the canes are trained by the weaving system each cane is woven separately on the wires and the largest possible fruiting surface is exposed to the sunlight. Figures 3 and 4 show canes trained in this manner.

When trained in accordance with the rope system, all the canes may be brought up to the top wire in a bundle and then wrapped



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FIG. 6.—A plant of the Mammoth variety trained in accordance with the rope system to a 2-wire trellis. The young canes are on the ground under the trellis.

around the wires, as shown in figure 5. The canes trained by this method are not exposed so much to the sun, but they are shaded by the foliage. In California, when the rope system is used, the canes are often divided into four parts—two parts tied to the lower wire and two parts to the upper wire—and half of those on each wire extend in each direction, as shown in figure 6. Occasionally in California a single-wire trellis is used and all the canes are tied to this one wire. A 1-wire trellis is rarely as satisfactory as a 2-wire or 3-wire trellis.

The weaving system requires much more labor in putting up canes, but growers consider that they obtain the largest yields of fruit

from such plantations. The buds are not as likely to be bound so that they can not develop as when the rope system is used. Large crops, however, are secured from plantations trained under either system.

Figure 7 shows a 50-acre field trained by the rope system, and figure 8 shows a large field trained by the weaving system.

In a new plantation the canes usually are not trained until the spring of the year following the setting, as it is possible to secure a large number of new plants by inducing the tips of the canes to root. The tips are buried in autumn, and by spring they are rooted and may be dug and sold. A considerable income may be secured from the sale of such plants, and the plantation will not be injured by this practice.



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FIG. 7.—A field of Logan blackberry plants at Salem, Oreg., showing the method employed in bracing the end posts.

Immediately after the harvesting season, when the plantation is in its second year, the canes that have fruited should be cut out and the new canes trained to the trellis. As the canes continue to grow until late autumn and become very long, they are much more difficult to train at that time than just after the fruiting season. Not only is the cost of the training less just after the harvest season, but there is much less danger of injuring the canes, as they become more brittle in autumn. The cost of keeping down weeds and grass is greater, also, where the canes are left on the ground. However, in sections where there is danger from winter injury growers have found it necessary to leave the canes on the ground until the following spring just before growth starts, at which time they are trained to the wire trellises. Canes are not so easily handled in spring, especially where

weeds and grass grow during the winter; therefore, where there is little danger of winter injury training should be done as soon as possible after the previous crop has been harvested and the old canes are removed.

Pruning shears are commonly used to remove the old canes, which should be cut out as near the ground as possible. No stubs as long as those shown in figure 9 should be left. In this illustration the old canes have been cut out and the new canes trained up. Figure 8 gives a more extensive view in the same field. The old canes may be seen in the alleys between the rows.

Ordinarily the old canes are left in the alleys and are cut to pieces and mixed with the soil. A 10-disk cultivator heavily weighted with



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FIG. 8.—Part of a field of Logan blackberry plants in which the old canes have been cut out and thrown in the alley and the young canes trained to a 4-wire trellis. This gives a glimpse of the oldest large commercial plantation in Oregon, still one of the most productive.

stone may be used for this purpose. The canes and foliage rapidly decay and furnish humus for the soil.

Where there is much danger of injury from anthracnose this practice should not be followed, as it is thought that there is danger of the disease spreading to the young canes from pieces of the old canes left between the rows. Such old canes should be removed from the field and burned, or they may be burned in a sled having a sheet-iron body which is drawn through the alleys. The body of this sled should be made like a box, with the sides 3 or 4 feet high. As soon as the canes have dried a little they can be thrown in the sled and burned without danger of injury to the young canes from the heat of the fire.

Where severe winds prevail the new canes should be left on the ground until early spring and should then be trained to stakes. A stake 5 or 6 feet high should be set by each plant and the canes wound about it in a spiral. The ends of the canes should be cut off at the top of the stake and the canes fastened to it with strong, soft string or with pliable wire, once near the top, once about midway, and again near the base of the stake.

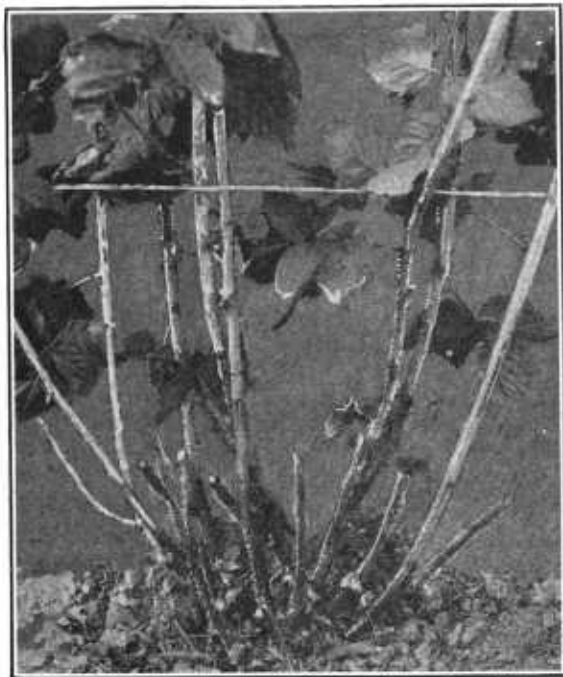
PRUNING.

Ordinarily very little pruning is done in Logan blackberry fields. If the plantation is growing vigorously and a wire trellis is erected, as already described, the canes can be trained on this wire at their full length. Occasionally, where the rope system, as illustrated in figure 5, is used, the canes will become so long that they will interfere with those of the next plant, when the ends should be cut off.

Sometimes canes are produced which are not long enough to be trained to the wire trellis. These should be removed, as they are an additional tax on the plant at the fruiting season, while their fruit would be likely to become gritty. It is best to leave as many strong canes as the plants will make and remove only the short and weaker ones. In some sections the plants will send out 7 to 10 canes, while in others the number often exceeds 15 canes to the plant.

HARVESTING.

The Logan blackberry begins to ripen a little later than the first raspberries and continues for about six weeks. In the Sebastopol section of California, the season usually begins about June 5 and



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FIG. 9.—Base of a Logan blackberry plant showing nine canes of the current season's growth and the stubs of the old canes. No stubs as long as those shown should be allowed to remain.

lasts until July 15. Near Salem, Oreg., it begins between June 15 and July 1 and lasts until August 1 or August 10, while in the Puget Sound region of Washington the season is slightly later. In the clear, sunny summers of the Pacific coast the fruit ripens quite uniformly and should be picked every second or third day. In a climate with humid summers the ripening is more irregular, and much more care must be used in picking. Three to five pickers per acre ordinarily will be required.

PICKING FOR THE FRESH-FRUIT MARKET.¹

Under efficient methods of handling, picking, hauling, and transportation, the fresh fruit of the Logan blackberry may be shipped long distances. The successful shipment of the fruit to distant markets has been made possible only through improved methods of

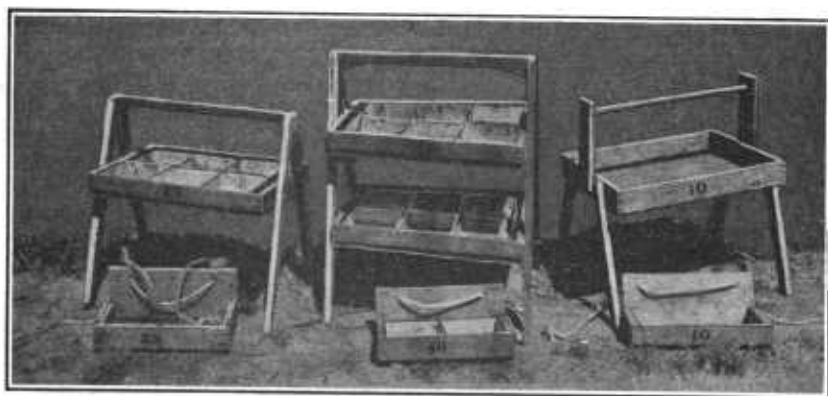


FIG. 10.—Some types of waist and hand carriers used in picking Logan blackberries. Each picker has a waist carrier numbered to correspond with the number on the hand carrier.

handling in the harvesting of the fruit and by the rapid and efficient transportation service afforded by the modern refrigerator express car attached to fast-moving mail or express trains.

The most common causes of early decay and deterioration are mold fungi, which develop rapidly at ordinary temperatures when once the fruit has become infected. It has been shown that the decay fungi attack the fruit through cuts and abrasions in the skin and that these organisms are unable to penetrate the healthy unbroken skin of a well-grown fruit. The rapid decay of shipments within 24 or 36 hours after the fruit is picked is due largely to fungi of this

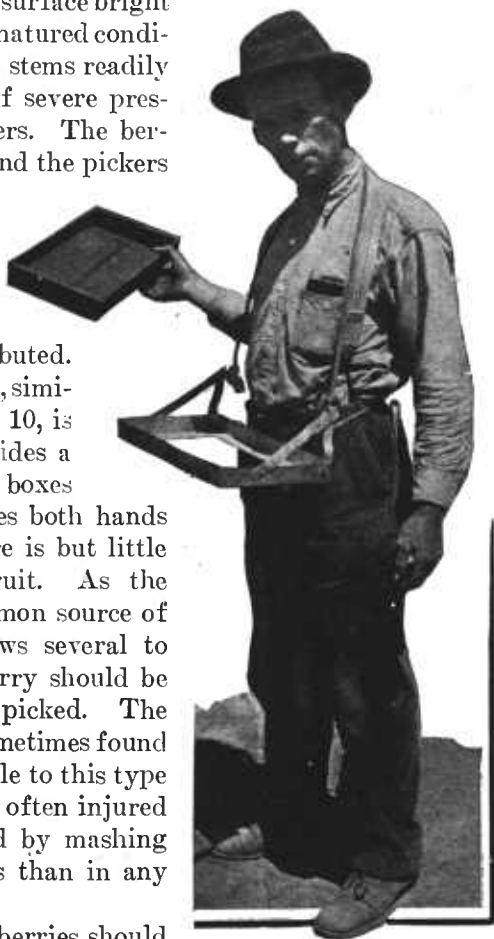
¹ Much of this matter on picking and handling Logan blackberries for the fresh-fruit market has been adapted from a report on investigations in the handling of the fruit, by C. W. Mann. For a further discussion of the handling of fruit for shipment, the reader is referred to United States Department of Agriculture Bulletin 274, entitled "Factors Governing the Successful Shipment of Red Raspberries from the Puyallup Valley."

class. The prevention of the losses resulting from these decay fungi lies in better methods of picking and handling in the field and in the prompt cooling of the fruit afterward.

When destined for the fresh-fruit market the berries must be picked several days earlier than when they are to be canned, evaporated, or used for jellies and preserves or for expressing the juice. They should be firm and the entire surface bright red in color. In a properly matured condition they will part from the stems readily and without the necessity of severe pressure from the pickers' fingers. The berries are more easily picked and the pickers can avoid crushing and injuries of this kind when three fingers are used instead of two, as the pressure required to loosen the berry is more evenly distributed.

In picking, a waist carrier, similar to those shown in figure 10, is commonly used. This provides a convenient way to carry the boxes while being filled. It leaves both hands free for the work, and there is but little danger of spilling the fruit. As the mashing of berries is a common source of injury when a picker allows several to collect in his hand, each berry should be placed in a cup as it is picked. The masses of decayed berries sometimes found in the cups are often traceable to this type of injury. Berries are more often injured by crushing in picking and by mashing in the hands of the pickers than in any other way.

All overripe and injured berries should be placed in separate cups and not mixed with the properly ripened, sound fruit intended for long-distance shipment. If pickings are made regularly and at close intervals little trouble from overripe berries should be experienced. No sorting in the boxes to remove injured or overripe berries should be allowed, as this will injure the shipping qualities of the fruit.



P20867HP
FIG. 11.—A picking carrier suspended from the shoulders, used chiefly in picking berries for the cannery, the evaporator, and the juice factories.

Boxes holding a pint are ordinarily used when the berries are to be shipped in the fresh state. As soon as filled, these boxes are transferred to hand carriers, which should always be set in the shade. As soon as the hand carrier has been filled, it should be taken to the packing house and the boxes transferred to crates. The berries should be hauled to the shipping point promptly and without delay either precooled and put into refrigerator cars or placed directly in iced refrigerator cars.

Carefully handled berries, cooled quickly after picking, retain their firmness, attractive appearance, and freedom from decay for the longest possible time after reaching the market. Early cooling is essential where the berries are to be shipped a considerable distance, in order to retard the ripening processes. The value of precooling in refrigerating plants is in checking deterioration, which goes on rapidly in high temperatures, but the decay of berries in the market as the result of rough or careless handling can not be prevented by precooling the fruit before shipment. More important than any process of precooling is careful handling in the field and in transportation. This is the principal factor in insuring the delivery in the market of sound fruit having good keeping qualities.

PICKING FOR THE EVAPORATOR.

If the berries are to be evaporated, they should not be picked until very ripe. They are then dark in color and soft. They should be picked without mashing, and hauled at once to the evaporator. Very ripe fruit will give a greater proportion of the dried product to the fresh fruit used than will berries somewhat green, and the dried product will be of better quality. If the berries are too soft, however, they will not hold their shape well, and the dried product will be unattractive and will not sell as readily as it otherwise would.

When berries are picked for the evaporator, cups and carriers like those shown in figure 10 may be used, or a large tray like that illustrated in figure 11 may be substituted. Whether the pint cups or large trays are used, they can be carried most easily and safely if the waist carrier is suspended from the shoulders, as shown in figure 11.

PICKING FOR THE CANNERY.

If the berries are to be canned, they should be picked while still firm, but after they have thoroughly ripened. They become sweeter and better flavored if left on the bushes until fully ripe, but they should not be allowed to become soft before picking, as soft fruit will break up in processing. Fruit such as is picked for the fresh-fruit market will make a prettier product after processing, but will be

much more acid than berries which have been allowed to ripen for two or three days longer.

PICKING FOR JUICE FACTORIES.

When berries are to be used in the manufacture of a beverage, they should be allowed to ripen on the canes more than is ordinarily allowed when intended for either the evaporator or the cannery. When perfectly ripe the berries contain more sugar than at any other time, and the juice then has the best flavor and aroma. Furthermore, the quantity of juice secured from berries which are fully ripened is very much greater than from those which are slightly immature.

Table I shows the percentage of juice obtained from berries which are underripe, medium ripe, thoroughly ripe, and overripe. It will be noted that the percentage of juice is very much greater when the berries are ripe than when they are somewhat green.

TABLE I.—*Effect of the ripeness of Logan blackberries on the quality of their juice.*¹

Sample.	Ripeness of berries used.	Percentage of juice obtained.	Rank according to quality.
No. 1.....	Immature.....	59.3	Fourth.
No. 2.....	Medium ripe.....	71.8	Third.
No. 3.....	Ripe.....	71.8	First.
No. 4.....	Overripe.....	78.1	Second.

¹ The figures presented in Tables I, II, and III are taken from Bulletin 117 of the Oregon Agricultural Experiment Station, by C. I. Lewis and F. R. Brown.

Table II shows the composition of the juice of the Logan blackberry. It should be noted that when the berries are overripe the percentage of sugar is greatest, while the percentage of acid is least.

TABLE II.—*Composition of the juice of the Logan blackberry.*

Juice obtained from—	Specific gravity.	Acidity (calculated as sulphuric acid).	Total sugar (calculated as dextrose).
		<i>Per cent.</i>	<i>Per cent.</i>
No. 1, immature berries.....	1.032	2.06	3.50
No. 2, medium-ripe berries.....	1.0395	2.10	4.91
No. 3, fully ripe berries.....	1.045	1.88	6.40
No. 4, overripe berries.....	1.040	1.78	6.46

UTILIZING THE FRUIT.

As already stated, Logan blackberries are extensively used as fresh fruit for evaporating, canning, and the making of jams and preserves and also for the fresh juice. There has been a steady and increasing market for the fruit for each of these purposes, although the demand for the juice has grown much more rapidly than that for the other products.

EVAPORATING.

If they are to be dried the berries are commonly handled in evaporators that are also used in drying prunes. The drying process takes from 12 to 36 hours. If a temperature of 130° to 160° F. is maintained, with a good circulation of air, the berries are dried sufficiently in about 16 hours. If the air circulation is increased by means of a fan the time required may be reduced very materially. In the ordinary prune drier 24 hours are required for the drying, while with the rapid circulation of the air the time can be reduced to about 12 hours. It takes about 5½ pounds of fresh fruit to make 1 pound of the dried product, depending upon the climate, the soil, the stage of ripeness at which the berries are picked, and the rapidity of evaporation.

Table III presents the result of experiments on the effect of high temperatures on the quantity of fresh fruit required to make 1 pound of the evaporated product. It will be noted that when a shorter period of time is taken the amount of dried fruit increases very materially.

TABLE III.—*Effect of high temperatures at the beginning of the process of evaporation of Logan blackberries upon the quantity of the dried product.*

Series.	Time of evaporating.	Pounds of fresh fruit required to make 1 pound of evaporated berries.	Temperature (° F.).	
			Start.	Finish.
No. 1.....	23 hours, 35 minutes.....	5.2	140	150
No. 2.....	14 hours, 22 minutes.....	4.8	130	160
No. 3.....	16 hours, 30 minutes.....	4.5	125	160
No. 4.....	16 hours.....	3.9	130	150
Average.....	17 hours, 37 minutes.....	4.6	131	155
Berries used as a check:				
No. 5.....	38 hours, 25 minutes.....	5.5	100	150
No. 6.....	31 hours, 55 minutes.....	5.6	90	155
No. 7.....	28 hours, 48 minutes.....	5.3	96	150
Average.....	33 hours, 3 minutes.....	5.5	95.3	151.6

It is essential that a high temperature be used at the beginning of the process. This not only reduces the time required for evaporation, but it increases the proportion of the dried product.

The cost of evaporating at the prices for labor and materials prevailing in Oregon in 1913 was between 2 and 3 cents per pound of the finished product.

CANNING.

When Logan blackberries are canned they should be put in only the best grade of lacquered cans. No. 2 and No. 10 cans ordinarily are used for the general commercial market. The berries are put up in

water and in sugar sirups of different densities. For the best results sirups of 50° and 60° Balling should be used. A 50° sirup is made by adding 8.3 pounds and a 60° sirup by adding 12.5 pounds of sugar to a gallon of water. One should consult the market requirements before putting the berries in a sirup of any particular density, as the different markets prefer berries put up in different ways. Processing takes about 16 minutes at a temperature of 212° F.

PREPARING THE JUICE.

Various types of presses are used in extracting the juice from the fruit. With a good press a gallon of juice should be secured from about 11 pounds of properly ripened berries, or 170 to 180 gallons per ton of fruit. The percentage of juice obtained from a given quantity of fruit will depend upon its ripeness, the soil on which the berries are grown, and to some extent upon the climatic conditions. Thus the berries listed as "immature" in Tables I and II yielded 135 gallons of juice per ton of fruit, the medium ripe fruit and the fully ripe fruit yielded 166 gallons per ton, while the overripe fruit produced 180 gallons per ton. Berries from moist soils contain a larger percentage of juice than those from soils lacking moisture; likewise, in very dry seasons berries may not contain as large a percentage of juice as in seasons of more abundant rainfall.

For making juice in the home, a small hand press of some kind may be used. Such a press should crush the berries thoroughly and press the juice from them. If a press is not available, they may be put on a stove with enough water added to cover the bottom of the vessel, and heated to a temperature of about 130° F. They should then be put in a clean cloth sack and the juice pressed from the berries by hand. The juice may be bottled without the addition of sugar, or a small amount of sugar may be added. A beverage of excellent flavor and appearance is made by adding 4 or 5 pounds of sugar to the gallon.

The juice should next be pasteurized by heating it to a temperature of 180° to nearly 212° F., but it should not be allowed to boil. Boiling impairs the flavor of the juice, while a temperature of 180° F. may be used without appreciable change in the quality. The pasteurized juice may be placed at once in sterilized glass jars or bottles and sealed, or it may be allowed to settle for 24 or 48 hours. The juice should then be separated from the sediment, pasteurized again, placed in the jars or bottles, and sealed. Only glass or enameled utensils should be used to hold the juice.

Juice made in this manner is concentrated, and before it is used as a beverage it should be diluted with about three parts of water to one of the juice.

YIELDS.

From a 1-year-old plantation which has been given good care, between 1 and 2 tons of fruit per acre ordinarily are secured. When the plantation is in full bearing, the yield will, of course, vary with the care given the plantation in different seasons and in different sections of the country. Growers, however, should not be satisfied with an average annual yield of less than 4 or 5 tons per acre. Many growers have been able to secure even larger yields than this.

DURATION OF PLANTATIONS.

Although the Logan blackberry originated in California, a plantation does not ordinarily last as long in that State as it does in Oregon. Figure 9 shows a field in Oregon nearly 20 years old which is still in excellent condition and bearing as much as or more than most younger plantations. In California, however, plantations usually do not continue in a profitable condition longer than six or seven years.

PROPAGATION.

In setting a new plantation tip plants are desirable, although plants are sometimes secured by layering or by root cuttings. The tip plants are sometimes grown for one season in the nursery before they are set in the field.

Tip plants are obtained from plantations by burying tips of the young canes during the late summer or autumn. The canes trail along the surface of the ground, and if the soil is mellow and a good supply of moisture is provided they will take root at the ends. Better plants, however, usually will be secured if the tips are buried in a few inches of soil. By the following spring plants suitable for setting in the field will have formed. If a larger number of plants are desired, the ends of the young canes may be pinched off when they are 4 to 6 feet long. Side branches or laterals will then grow from the nodes along the canes and will root in the autumn. If the conditions are favorable, these laterals will make as strong plants as if only one new plant were produced by each cane, and such plants will be fully as productive as those formed by a cane which has not branched. A cane which has been forced to send out laterals and to make many tip plants will not bear as well the following year as a cane which has been allowed to grow to its full length and to form only a single plant at the tip. The plant itself, however, will not be injured by this practice. Growers of the Logan blackberry can add materially to their incomes by supplying tip plants to nurserymen and to those who plan to set new plantations, and, in practice, most of the nursery trade is supplied by those who grow this variety for its fruit, but who get an additional income from the sale of tip plants.

Another method of propagating the Logan blackberry is to make cuttings of the roots about 3 or 4 inches long and bury them in the winter in trenches at a depth of 3 or 4 inches. Some of these pieces of root will develop into fair-sized plants by the end of a year. Roots will also be formed at the nodes if the canes are covered with soil in the autumn. The formation of roots will be hastened, however, if slits are made on the under side of the nodes. This method of propagation is not often satisfactory and is rarely used.

Transplants, that is, rooted tip plants which have been grown in the nursery for a year before being set in the field, are rarely used. Such plants cost \$10 to \$12 per thousand more than newly rooted tip plants, are much more costly to handle and plant, and in California at least are much shorter lived.

Seeds of the Logan blackberry will germinate readily, and plants can be grown from them. They will not be exactly like the Logan plant, however, and nearly all will bear fruit inferior to it. Propagation by seedage, therefore, is practiced only by those trying to secure varieties similar to the Logan, but better in some way.

- RELATED FORMS AND HYBRIDS

There are several forms of blackberries and blackberry-raspberry hybrids which are closely related to the Logan blackberry, are trained in a similar manner, and are grown under similar conditions. Descriptions of the more important of these are given below.

Laxton (*Laxtonberry*).—This is the only *Rubus* hybrid in the trade at the present time which has the Logan blackberry as one parent. It is the result of a cross between the Logan blackberry and the Superlative red raspberry, and was originated by the Laxton Brothers, of England. In central California its fruit is of fine quality, milder in flavor than the Logan variety, similar in color and separating from the receptacle somewhat like a raspberry, but not easily enough to avoid mashing in picking. Its blossoms are only partially self-fertile, and it should be planted adjacent to the Logan blackberry or to a red raspberry. Because it mashes when picked, it does not appear to be of commercial value for any part of the United States.

Lowberry.—Another hybrid having the Logan as one parent. Plants grown in this country bear fruit resembling the Laxton and can not be picked without mashing.

Mahdi.—This is a hybrid between the Fontenay red raspberry and a native English blackberry and is in the trade at the present time. It ripens later than the Logan. It is of doubtful value, as the berry does not separate from the receptacle like a raspberry nor pick off like a blackberry, but mashes in picking.

Mammoth (*Lowberry*, *Black Logan*).—This variety was originated by Judge Logan at the same time the Logan appeared and is supposed by him to be a hybrid between the Crandall and the Aughinbaugh blackberries. Figure 6 shows a bush of the Mammoth variety trained to a 2-wire trellis. The plants are vigorous and should be set about the same distance apart as the Logan variety, although some growers prefer to set them slightly farther apart. The canes are trained and pruned like those of the Logan blackberry. As the blossoms are self-sterile, the plants must be set adjacent to those of the Logan or some other blackberry blooming at nearly the same season. The fruit is well adapted to fresh-fruit markets, but this variety is not adapted to utilization in the form of by-products. It is the standard blackberry of its season in California, but is grown very little elsewhere.

The canes are very vigorous, at first erect, but after reaching a height of 3 or 4 feet becoming trailers, often growing 20 to 30 feet long, rooting at the tips as do the canes of the Logan variety; slightly more tender than the Logan; blossoms self-sterile; berries larger than any other blackberry in cultivation at present, sometimes more than 2 inches in length; black; too soft for long shipments, sweet; dessert quality very good in California but only fair in most sections of Oregon and Washington; season about 10 days later than the Logan.

Other varieties similar to the Mammoth are the Tribble blackberry, which has been grown very little, and a new variety, called the Cory, which though it bears fruit much like that of the Mammoth has canes which are said to be thornless.

Phenomenal.—This variety was introduced by Luther Burbank and is not easily distinguished from the Logan. In many sections, because of a disease which causes a dwarfed growth of the plants, only two or three crops can be harvested before the plantation becomes unprofitable. It is, therefore, considered less desirable than the Logan variety except in certain localities near Los Angeles, where it is sometimes preferred.

Compared with the Logan blackberry, the plants are more subject to the dwarfing disease and are shorter lived; the canes are reported slightly hardier; the blossoms are a few days later in opening; the berries are slightly larger, but of the same color, and are somewhat inclined to grow double (as shown in fig. 1), which gives them a poor appearance and makes them undesirable for market; the juice is reported less suitable for beverage purposes, but the flavor is similar.

Primus.—This is another introduction of Luther Burbank. It is being discarded because the blossoms are so often injured by frosts and because it is difficult to get the berries marketed in good condition.

The canes and foliage are very similar to the Logan variety; blossoms earlier, hence its liability to frost injury; berries large, very soft, black, quickly turning dull and unattractive, not separating easily from the stems, usually mashed to some extent in picking; season much earlier than the Logan blackberry, most of the crop maturing before the season of that variety begins.

Other varieties.—Another variety which is grown slightly on the Pacific coast is the Champion. Its origin is unknown and it is not considered desirable for general cultivation. A variety which may be identical with it is the Atlas, although the name Atlas is sometimes applied to the Evergreen blackberry. Another variety very similar to the Logan is the New (*Newberry*).